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BULLETIN OF THE
U.S. DEPARTMENT OF AGRICULTURE

No. 1

Contribution from the Bureau of Animal Industry, A. D. Melvin, Chief.
September 17, 1913.

MEDICAL MILK COMMISSIONS AND CERTIFIED MILK.[1]

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THE WORK OF MILK COMMISSIONS.

The organization of milk commissions in this country was an important step toward the improvement of the quality of milk. While the number of commissions is very limited and the milk produced under their supervision amounts to only a small proportion of the milk annually consumed, the great value of certified milk to invalids and its influence in reducing the mortality among infants and children are beyond estimation. Further, the work of milk commissions has had no little influence in improving the general milk supply of cities where such commissions exist, by setting a higher standard of quality and by creating public sentiment in favor of pure milk.

THE FIRST COMMISSION: ITS ORGANIZATION AND OBJECTS.

The beginning of this movement dates back to 1889, when the Medical Society of New Jersey made an effort to improve the milk production in that State. A committee was appointed to make an investigation of the milk supply as far as it affected the public health. After two years' work this committee submitted a report condemning many of the methods employed in the production and handling of milk and advising an appeal to the State for a strict scientific supervision of all the dairies within its limits. The appeal was made, but failed. While the need was admitted, the authorities pleaded lack of funds for making the changes suggested.

This effort having met with defeat, another line of work was resorted to. The chairman, a Newark physician, presented a plan in 1892 to the Practitioners' Club of that city whereby physicians might themselves supervise the production of milk and thus be perfectly sure of its purity. The requirements for the production of certified

[1] An extensive revision of Bulletin 104, Bureau of Animal Industry, Medical Milk Commissions and the Production of Certified Milk in the United States, by C. B. Lane, 1908.

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milk were given with the utmost detail. It was recommended that a milk commission be formed by physicians who should certify to the milk over their names provided the requirements were fulfilled. This plan was indorsed by the Practitioners' Club, and a search was begun for a dairy with equipment suited to such rigid regulations. A dairy was found which had already set such a high standard that the methods used could readily be accommodated to the requirements of the medical commission.

Having secured a dairyman who was ready to bind himself by contract to conduct his dairy in accordance with the requirements, physicians from Newark, Orange, and Montclair were chosen to make up the first milk commission, which was organized April 13, 1893, and the production of what is known as "certified milk" was begun. This commission was named "The Medical Milk Commission of Essex County, New Jersey." Since this was organized about 65 others have been or are now being formed in various cities on a similar plan. A description of the first will therefore serve to give a general idea of milk commissions and their work.

OBJECTS OF THE COMMISSION.

The objects and requirements of the commission were stated as follows:

> The objects of this commission are to establish correct clinical standards of purity for cow's milk; to become responsible for a periodical inspection of the dairies under its patronage; provide for chemical and bacteriological examinations of the product, and the frequent scrutiny of the stock by competent veterinarians; to promote only professional and public interests.
>
> The following are three general requirements or standards for the milk: (1) An absence of large numbers of microorganisms, and the entire freedom of the milk from pathogenic varieties; (2) unvarying resistance to early fermentative changes in the milk, so that it may be kept under ordinary conditions without extraordinary care; (3) a constant nutritive value of known chemical composition, and a uniform relation between the percentage of fats, proteids, and carbohydrates.

THREEFOLD EXAMINATION BY EXPERTS.

A chemist and a bacteriologist examine samples of the milk, which they obtain themselves, twice each month, and report their findings to the commission. A veterinarian examines the cows twice a month and makes report. Representatives of the commission in person make a monthly inspection of the dairy and report to the others.

The veterinarian must show the milch cows to be in perfect health. The chemist must show the milk to contain the required amount of solids and to be free from all foreign matter. The bacteriologist must show the absence of all disease-producing bacteria and a minimum of bacteria of all sorts. Only in case all these reports are satisfactory does the commission certify to the milk.

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ORIGIN AND MEANING OF THE TERM "CERTIFIED MILK."

The term "certified milk" originated with the member of the commission who formulated the plan. At the instance of the commission the word "certified" was registered by Mr. Francisco in the United States Patent Office on October 16, 1904, under registry No. 25368, the object being to protect it from being degraded by dairymen not under contract with a medical commission. It was distinctly understood, however, that the use of the term should be allowed without question when employed by medical milk commissions organized to influence dairy work for clinical purposes.

Dr. Henry L. Coit, of Newark, N. J., who has been called "the father of certified milk," gives the following definition[1] of certified milk:

> Milk from a lower animal which has been certified by a medical milk commission appointed by a medical society, which certification is the monthly authorization for the commercial use of the term and which certificate is based upon the commission's investigation relative to the production of the milk showing that it conforms to the standards of quality and purity for certified milk and the methods and regulations for the production of certified milk, which standards of quality consist of a fresh milk, unchanged by either heat or cold, less than 24 hours old when sold, and which contains not less than 12 per cent of total solids, with not less than 3.5 nor more than 5.5 per cent of fat, to which have not been added any other food principle, chemical substance, or preservative, which standards of purity for the milk consist of the lowest possible bacterial and dust-dropping content consistent with the highest possible practice of dairy hygiene, provided that the average numerical contamination is not above an average weekly count of 10,000 bacteria per cubic centimeter, and from which milk every known method has been employed to exclude pathogenic microorganisms, and which standards of purity are safeguarded by a medical guaranty of the health and personal hygiene of every employee handling the milk and by a veterinary guaranty that the milk herd will not be a carrier of any disease to those using the milk for food; which methods and regulations for the production of certified milk are carried on in conformity with those adopted by the American Association of Medical Milk Commissions and are changed from time to time as the action of this association modifies the technique for the attainment of the standards of quality and purity for certified milk growing out of improved methods and regulations for its production.

THE CONTROL OF DAIRIES.

Some commissions—particularly such as have under their supervision only one dairyman who both produces and distributes certified milk—enter into a binding contract with the dairymen. This contract contains a more or less complete and detailed statement of the conditions under which certified milk must be produced and marketed; specifies standards for composition and bacterial content of

[1] This definition is modified somewhat in view of the fact that at the sixth meeting of the American Association of Medical Milk Commissions changes were made in the chemical standards outlined by Dr. Coit.

the milk; provides for inspection of premises, examination of cows, and collection and analysis of milk samples; and includes provisions under which the contract may be terminated by either party entering into it.

Many commissions prefer not to have any contract with their producers and claim that it is superfluous and unnecessary. The producers understand well that if their milk does not come up to the requirements they can not sell it. However, in cases where there are contracts, commissions are not at all hasty in severing relations with a producer when his milk falls below requirements, but make more frequent inspections and lend every effort at such inspections to help the dairyman out of his trouble. In this way when a producer does have trouble he often writes to know when the commission can send a representative to help him out of his difficulty. The efforts of such commissions are therefore to help and cooperate closely with the producer. Some commissions feel safer in the work without a lengthy binding contract. This plan allows a certain latitude for meeting conditions as they arise, and the latter vary greatly at different farms, even though the dairymen all produce milk well within the requirements and standards.

REQUIREMENTS AND STANDARDS.

There has been in the past considerable diversity as to the requirements of the various commissions concerning the production of certified milk. In the spring of 1912 a report was received from 58 milk commissions as to the standards which they had set for both chemical composition and bacterial content.

The requirements for fat range from 3.5 up to 5 per cent, while the standards for total solids range from 12 to 14 per cent. By far the greatest number of commissions required that the bacterial count be kept below 10,000 per cubic centimeter, one of the commissions requiring a count under 5,000 in the wintertime. One commission allowed 15,000, one 20,000, and three 30,000 bacteria per cubic centimeter. It has been generally recognized, however, by those connected with certified-milk work that a standard of 10,000 bacteria per cubic centimeter is that which is usually associated with certified milk.

In order to make the requirements more specific and to unify the work of the various milk commissions, the American Association of Medical Milk Commissions appointed a committee to draw up tentative standards which should be adopted by the association for the production and distribution of certified milk. The report of this committee was read and accepted at the meeting of the association held in Louisville, Ky., May 1, 1912, and the provisions of this report are looked upon as standard regulations for this product. These rules are reprinted in the appendix of this bulletin.

METHODS AND WORK OF THE VARIOUS MILK COMMISSIONS.

NUMBER OF COMMISSIONS AND WHEN ORGANIZED.

As previously stated, the first milk commission was organized April 13, 1893. An effort has been made to get correct data as to when subsequent commissions were organized, but this has proved an exceedingly difficult thing to do. Several commissions have given two different dates of organization, which is rather confusing in compiling statistics. This is probably due to the fact that many commissions were in existence and then for some reason or other became inactive for one or more years and were afterwards reorganized and carried on the original work. Fifty-four commissions reported the dates of their organization, and from their answers the following table has been arranged:

Year of organization.	Commissions organized.	Year of organization.	Commissions organized.
1893	1	1905	2
1896	1	1906	5
1899	1	1907	6
1900	1	1908	14
1901	1	1909	7
1902	3	1910	6
1903	1	1911	2
1904	2	1912	1

The most rapid increase is seen to have taken place from 1906 to 1908, and since that time the increase has somewhat fallen off. This falling off in the number of commissions organized is probably explained by the fact that the field is being better covered so that new commissions are less needed than formerly.

Not only has this movement spread in this country, but two or three commissions have been formed in Canada which conform to the same standards as those in the United States.

In order to obtain information as to the medical milk commissions a large number of circulars were sent out to the various commissions in the spring of 1912. Replies were received from about 65 commissions, and it was found that quite a large number of these had become inactive either through lack of demand for certified milk or because of inability to find dairymen who would submit to the regulations of the commission.

NUMBER OF CERTIFIED DAIRIES AND QUANTITY OF MILK PRODUCED.

The number of dairies producing milk for any one commission varies from 1 to 20. Several commissions were found to be still in

existence and to have a full complement of officers, but not certifying any milk at the time of reporting. The following table shows the number of dairies certified by each commission:

Dairies certified.	Commissions.	Dairies certified.	Commissions.
None	20	5	3
1	19	6	1
2	10	10	1
3	4	12	1
4	3	20	1

Out of 63 commissions reporting as above, 20 had discontinued the certification of milk. The smallest amount certified by any one commission is 75 to 100 quarts a day, while the greatest amount which is passed upon by a single commission is 10,752 quarts a day. A few commissions certify cream as well as milk. Ninety-two certified dairies answered the question blanks sent out, and they report the total quantity of milk produced as 16,633 gallons a day. As there are about 125 certified dairies in all, it seems probable that the total production reaches 25,000 gallons.

The 63 commissions answering the letter reported the certification of 126 dairies. A former investigation (Bureau of Animal Industry Bulletin 104) showed that on January 1, 1907, there were only about 6,000 gallons a day of certified milk produced; so that in five years there has been an increase in the production of certified milk of about 300 per cent.

INSPECTED MILK.

Several of the medical milk commissions are supervising the production of a special grade of milk which is called "inspected milk." This milk does not conform to all the requirements for certified milk, but is still of a high quality and much safer than the ordinary market milk of most cities. It is usually demanded that the cows kept for the production of this milk be free from tuberculosis and that the bacterial count shall be under 100,000 to the cubic centimeter. This milk sells for a less price than does certified milk, and is therefore within the reach of a larger class of consumers. One commission reports that it is inspecting 9 dairies in addition to those certified. The total number of "inspected" dairies reported was 20. The inspection of dairies seems to serve a double purpose, in that it not only puts a clean milk, which is produced under medical supervision, in the hands of the consumer at a reasonable price, but it also serves as a school for dairymen who may contemplate at some future time the production of certified milk.

INSPECTION OF DAIRY AND PRODUCT.

The answers from the various commissions relative to inspections show considerable variation. In some instances the inspections are made by members of the commission and in others paid inspectors are employed to do the work. As a rule, inspections of the dairy are made monthly by either a veterinarian or a member of the commission, or both, and in some instances inspections are made every two weeks. The tuberculin test is usually applied annually, but in some cases this is done every six months. Chemical and bacteriological examinations range all the way from once a week to once in two months; in most instances, however, it is the practice to make tests every two weeks or oftener.

HEALTH OF EMPLOYEES.

The employees in certified-milk plants are required to be clean in habits and appearance and are not admitted to the stables or dairy if not in good health. Some commissions require that employees be regularly examined by a physician and given certificates of health. In some certified-milk plants attendants when ill are cared for in a building specially set apart for the purpose.

PRECAUTIONS TO PREVENT SPREAD OF CONTAGIOUS DISEASES.

Where a large milk business is conducted and several thousand customers are served daily, there is danger that some contagious disease may be brought into the dairy in some of the bottles. To avoid this, in some instances a wagon makes a special trip to collect bottles from any house where a contagious disease is known to exist. These bottles are thoroughly boiled in a special room before they come to the dairy proper. They are then subjected to the same cleansing process as all the others.

SOME GENERAL CONSIDERATIONS.

IS THE DEMAND FOR CERTIFIED MILK INCREASING?

Although there has been a remarkable increase in the quantity of certified milk produced between 1907 and 1912, it must be admitted that the demand is not as great as might be expected. In nearly all localities it is a hard fight for the milk commissions to educate the consumers to the consumption of certified milk. There are two main reasons for this. First, it has been found that there is a general apathy among consumers as to the purity of their milk supply. This would hold good as well with certified as with market milk. Another reason is that the price of certified milk is considerably higher than that of market milk, and it is hard to get people to pay the extra cost. Reports were received from 45 commissions as to the

demand for certified milk. Three of these were indefinite. Only 10 out of this number reported that the demand was increasing rapidly; 1 more stated that the demand was fair, 2 that the demand was increasing steadily, 2 that there was a moderate demand, and 4 that the increase was gradual. This gives a total of 19 commissions that found that the demand was increasing in a satisfactory manner. The other 23 answers were divided as follows: Not a rapid increase, 12; very slow, 1; slight increase, 2; slow increase, 7; limited, 1.

It appears from these answers and from the results tabulated that while certified milk is increasing its sphere of influence, the increase is very slow, and at the present time only about one-half of 1 per cent of the total milk supply of this country is certified. One commission made the report that the demand was fairly good, but no dairyman was willing to supply it. Another commission accounted for the slow increase in the demand for certified milk by saying that the use of certified milk was limited because of the superior quality of the market milk in the city where the commission was located.

PRICES OF CERTIFIED MILK COMPARED WITH THOSE OF MARKET MILK.

The prices of certified milk to the consumer vary in different cities from 10 to 20 cents a quart, the average price for all cities being about 14.2 cents. The price of ordinary market milk in the same cities varies from 5 to 12 cents a quart and averages about 7.8 cents. Certified milk therefore sells for an average of 6.4 cents a quart more than market milk. As a rule, where the price of market milk is low, the price of certified milk is also comparatively low, although this does not hold true in all cases.

It was found in 1907 that the average price of certified milk was $12\frac{1}{4}$ cents a quart, and the average price of market milk was $7\frac{1}{4}$ cents a quart. It will be seen from the foregoing figures that while the average price of market milk has increased only about 0.6 of a cent a quart, the average price of certified milk has increased about 2 cents a quart.

THE INFLUENCE OF CERTIFIED MILK.

While certified milk is in a class by itself and does not enter into competition with ordinary grades of market milk, it has much educational value in cities where it is used. There is no doubt that the advertising of certified milk does much to inform consumers that clean milk costs more than dirty milk and that a cheap milk is apt to be dangerous.

The influence of certified milk on dairymen in general is a little more complex. Certified dairies have certainly shown how to produce the finest grade of milk and have served as models along this

line. An unfortunate feature has been that many of them have been operated at a financial loss, and this has had a demoralizing effect upon many dairymen, who have been led to believe that the production of clean milk necessitates the outlay of large sums of money in expensive equipment.

SO-CALLED CERTIFIED MILK NOT CONTROLLED BY MILK COMMISSIONS.

There are a few dairymen who sell their product under the name of certified milk who have no connection with the milk commissions. These, in some cases, certify to their own product, and in others samples are sent to a State experiment station or to some local chemist or bacteriologist for examination. Some dairymen in this class supply a very creditable product. There are others whose milk is of only ordinary quality. Here, again, the samples for analysis are usually taken by the dairyman himself from milk fresh from the cow and immediately iced and sent to the analyst. The analyst reports his results and the dairyman uses them to advertise his product. This can not be looked upon as anything but a deception, as the consumer is given to understand that this is the analysis of the milk as it is delivered to him daily. It is only when medical milk commissions have been organized and a plan of education has been started to create a demand for sanitary milk designed for infant feeding that there arises any danger of an impure milk being put on the market under such a label. It is manifestly unfair, therefore, that after a commission, serving without pay in the interest of the public, has created a feeling that "certified" milk means a safe, clean milk for infant feeding, some unprincipled dairyman should be able to prey on the ignorance of the public and supply an unsafe milk at a high price. Some steps should be taken by the milk commissions or by city or State officers to prevent such practices. Where milk is an article of interstate commerce, however, the national pure-food law covers misrepresentations of this character.

LEGALIZATION OF THE TERM "CERTIFIED MILK."

The State of New York has set a good example in passing a law for regulating the sale of certified milk. A portion of the law reads as follows:

> No person shall sell or exchange, or offer or expose for sale or exchange, as and for certified milk any milk which does not conform to the regulations prescribed by, and bear the certification of, a milk commission appointed by a county medical society organized under and chartered by the Medical Society of the State of New York and which has not been pronounced by such authority to be free from antiseptics, added preservatives, and pathogenic bacteria in excessive numbers. All milk sold as certified milk shall be conspicuously marked with the name of the commission certifying it.

New Jersey has also passed a very stringent law governing the production of certified milk. This act was approved by the governor on April 21, 1909, and a section of it reads as follows:

11. No person, firm, or corporation shall sell or exchange or offer or expose for sale or exchange as and for certified milk any milk which is not produced in conformity with the methods and regulations prescribed by and which does not bear the certification of a medical milk commission, incorporated pursuant to the provisions of this act or organized or incorporated in some other State for the purposes specified in section 1 hereof, and which is not produced in conformity with the methods and regulations for the production of certified milk from time to time adopted by the American Association of Medical Milk Commissions, and which is below the standards of purity and quality for certified milk as fixed by the American Association of Medical Milk Commissions; and any such person, firm, or corporation violating any of the provisions of this section shall be guilty of a misdemeanor.

The State of Kentucky also defines certified milk in the following words:

An act for preventing the manufacturing and sale of adulterated or misbranded foods, drugs, medicines, and liquors and providing penalties for violation thereof.

Section 3, paragraph 3. If in the case of certified milk it be sold as or labeled "certified milk," and it has not been so certified under rules and regulations by any county medical society, or if, when so certified, it is not up to that degree of purity and quality necessary for infant feeding.

California has also passed a law governing certified milk, and several other States contemplate such legislation.

Michigan has seen fit to recognize the importance of this subject and has passed a law which varies somewhat from the other laws. The Michigan act provides that any board of health having two or more physicians among its membership is authorized to appoint five physicians as a medical milk commission to supervise the production of certified milk. In towns not having a board of health so constituted the State board of health may make the appointment.

FINANCIAL SUPPORT OF MILK COMMISSIONS.

Members of milk commissions rarely receive any pay for their work, their services being given gratis for the public good. Small expenses of the commission are usually met by the commission itself. Occasionally philanthropic subscriptions are received. In one city three men contributed $800 after an appeal by the commission. Postage, printing, and salaries of experts are usually paid by the producers.

There is no uniformity regarding the charges for certification. Some commissions make absolutely no charge, while others charge the actual expenses of the various inspections and examinations to

the dairymen. The following is a list of some of the charges made by different commissions at the present time:

$40 a year for each dairy.
$10 a month.
$25 a year for each 100 cows.
$8 a month for 100 quarts.
$60 a year for each dairy.
One per cent of the retail price.
One-half the cost of the bacteriological examinations.
$10 per 1,000 caps.
$5 per 1,000 caps.
$4 per 1,000 caps.
$3.50 per 1,000 caps.
$1.25 per 1,000 caps
One-third of a cent a quart.
One-fourth of a cent a quart.
One and one-half cents a quart.

It would seem that the most equitable charge for certification would be by the sale of caps bearing the seal of the commission. This is done in a majority of cases, but, as can be seen, the charges vary over a wide field.

THE AMERICAN ASSOCIATION OF MEDICAL MILK COMMISSIONS.[1]

The spread of the certified milk movement was undoubtedly retarded because of the difficulties that presented themselves to those who had such an organization in contemplation. The subject was not broadly understood by the medical profession, and even when the organization of a milk commission was determined upon it was difficult to arrive at the most acceptable plan of organization and detail of working methods.

The usual procedure was to get into correspondence with one of the older commissions, which would relate its individual way of handling this problem. If the plan submitted seemed unsatisfactory, other commissions would be written to, and so an endless correspondence resulted, which proved especially burdensome to the Newark, N. J., commission.

The secretary of the Cincinnati commission, Dr. Otto P. Geier, encountered this same difficulty at the period of organization of that commission. It resulted in his sending out a series of 24 questions covering every phase of activity in milk commission work. These were addressed to every commission then known. This very exhaustive tabulation showed that there existed considerable lack of uniformity as to organization, working methods, supervision of dairies, chemical and bacteriological standards, methods of bottling, capping, and sealing, etc.

[1] The writer is indebted to Dr. Otto P. Geier, secretary of the American Association of Medical Milk Commissions, for data regarding the organization of the association.

Out of this mass of correspondence an attempt was made to arrive at the most acceptable standards and working factors, and the conclusion was reached that a conference of the milk commissions would be most valuable to all concerned.

In February, 1907, the Cincinnati commission addressed the various milk commissions suggesting a conference to be held in connection with the meeting of the American Medical Association at Atlantic City. Out of this grew a temporary organization. Dr. Henry L. Coit, Dr. Otto P. Geier, Dr. Samuel McC. Hamill, Dr. Rowland G. Freeman, Dr. William H. Park, and Dr. Thomas W. Harvey, acting as a committee, formulated a program and called the conference for June 3, 1907, at Atlantic City.

This initial conference was remarkable in that delegates were present from 12 different States, representing 21 commissions in as many cities. Over 100 physicians and leading hygienists attended this meeting, and a tremendous amount of work was accomplished. Reports were read by delegates as to the work of their particular commissions. Papers were presented on the broad topic of a pure-milk supply for cities. A permanent organization was effected, to be known as the American Association of Medical Milk Commissions, and the following officers were elected:

President, Dr. Henry L. Coit
Secretary, Dr. Otto P. Geier.
Treasurer, Dr. Samuel McC. Hamill.
Council: Dr. Rowland G. Freeman, chairman (5 years); Dr. Henry Enos Tuley (4 years); Dr. C. W. Brown (3 years); Dr. A. W. Myers (2 years); Dr. H. L. K. Shaw (1 year); and the president, secretary, and treasurer of the association.

Committees were appointed upon every phase of activity in milk certification to investigate and report at the next annual meeting.

It can be said that this meeting marked a new era in the pure-milk crusade. It is agreed that this organization is in position to crystallize the best thought that has been given to this subject, and that through such central organization quick dissemination of that knowledge will follow.

The constitution of this association declares its object in the following language:

> The purpose of this association shall be to federate and to bring into one compact association the medical milk commissions of the United States; to exchange views and to adopt uniform methods of procedure in the work of the medical milk commissions; to fix chemical and bacteriological standards; to determine the scope of veterinary inspections; and to foster and to encourage the establishment of medical milk commissions in other cities.

A better understanding of this subject will reveal the fact that milk commissions are widening their scope, and that through their activity the quality of the general supply of milk in the large cities

is being elevated. It will show that it is practicable for any medical association to form such a commission, which, once formed, will be most useful in educating the public as well as the profession and in creating a demand for a cleaner milk supply, and will thus further the efforts of boards of health.

THE PRODUCTION OF CERTIFIED MILK.

EQUIPMENT AND METHODS.

In the following pages is given a short description of the equipment and methods that are used at the present time among the various dairies that produce certified milk.

The Dairy Division is ready at any time to furnish working blue prints for the construction of barns and milk houses in which certified milk may be produced and handled.

STABLES.

The stables in which the cows are housed for the production of certified milk are built of various materials and vary greatly as to their arrangement and cost. In the past certified stables have been built mostly of wood or brick, but of late there have been a few stables erected entirely of concrete. Feeding floors, walks, and gutters are nearly always built of cement, and in a number of cases the platform on which the cows stand is also built of this material. Some certified dairies use wood for this purpose, and a few are using cork brick for the cows to stand on.

While many of the certified barns at the present time are built with a storage loft for feed overhead, it is thought that the best practice is to have the cows in a separate one-story structure.

A great deal of money has been spent in some certified-milk plants in finishing the stable in an elaborate manner with tile and expensive trimmings. Experience would seem to show that good results can be secured in an inexpensive barn, provided the proper precautions are observed. The floors should be smooth, nonabsorbent, and easily cleaned; the gutters should be capacious; the walls and ceilings should be absolutely smooth so that they may be easily kept free from dust and other dirt. Square corners and ledges should be avoided. The barns which are most easily kept clean are built with rounded corners and no horizontal ledges where dust may accumulate. It facilitates work if running water is available in a barn, so that the floors and walls may be washed down with a hose.

At least 500 cubic feet of air space and 4 square feet of window glass per cow should be allowed. Many certified stables are built with a much greater window allowance. Sunlight acts as a disinfectant in the stable and adds much to the attractiveness of the building.

Views of stables are shown in Plates I and II.

DAIRY HOUSES.

Milk houses on certified farms vary almost as greatly as do the stables. Stone, brick, wood, and cement are used for their construction. The same rules regarding the absence of ledges and the smoothness of the walls, floors, and ceilings should be observed. An entirely separate room should be provided for handling the milk, and in the majority of certified dairies this room is kept tightly closed while milk is being bottled and no visitors are allowed access to it. In some of the milk rooms air is supplied through a filter, so that there is no danger of bacteria being admitted from the outside air. Screens should be provided for all openings in the milk house, and there is no excuse for flies in the milk room.

HEALTH AND CLEANLINESS OF CATTLE.

The medical milk commissions require the tuberculin testing of the herds under their supervision. In addition, any cows showing abnormal symptoms or any form of disease which might affect the milk are eliminated from certified herds. The cattle are carefully groomed at least once a day so that there can be no accumulation of filth upon them, and in many dairies the cows' tails are washed daily. Many certified-milk producers are in the habit of clipping the hairs from the udders, flanks, legs, and bellies of all the animals, so that they are the more readily kept clean. A few certified dairies have installed vacuum cleaners with which the cows are cleaned previous to milking. These cleaners take up much of the dust, loose hairs, and scurf which would simply be brushed into the air of the stable by hand cleaning. After the cows are cleaned they are fastened so that they can not lie down until the milkers are through.

REMOVAL OF MANURE.

Wherever practicable the manure should be carried to the field daily. Many dairies follow this custom and find it economical, in that the manure does not have to be handled twice, as it would were it kept in a pit. At other dairies covered pits are built for the reception of the manure. Where these are built they should be of water-tight construction and should be tightly screened and covered to keep out flies.

BEDDING.

While straw is used for bedding in some of the certified dairies, a large number use either planer shavings or sawdust. Baled shavings may be had at a nominal price and make a very satisfactory bedding in sanitary dairies. As fast as these shavings are soiled or become damp they should be removed with the manure and replaced with clean, dry shavings.

FEEDING.

On account of the dust and odors which arise from the feeding of hay, grain, and silage, nearly all certified dairies prefer to do the feeding after milking has been completed.

BARNYARD.

The barnyard should be well drained and kept free from all filth. If good natural drainage can not be secured it is sometimes necessary to fill in the barnyard with coal ashes, gravel, shells, or some other drainage material. Sometimes underdrains are put in to carry away superfluous moisture. As the cows often lie down in the barnyard,

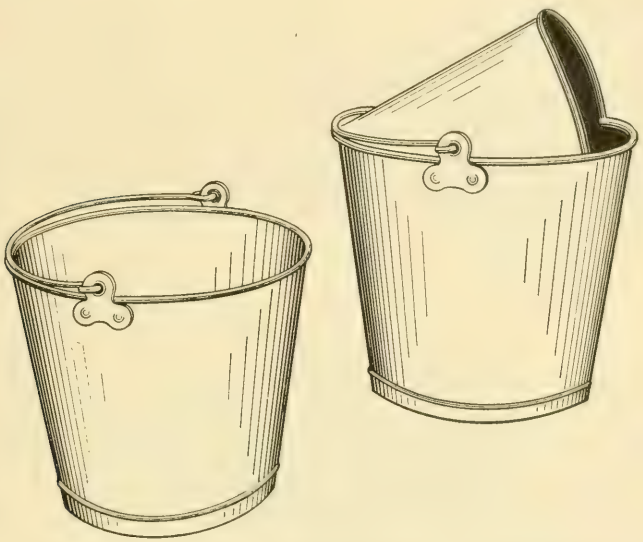


FIG. 1.—Ordinary milk pail made into a small-top pail by the addition of a hood.

it is important to keep the yard clean, so that they may not become unnecessarily dirty.

UTENSILS.

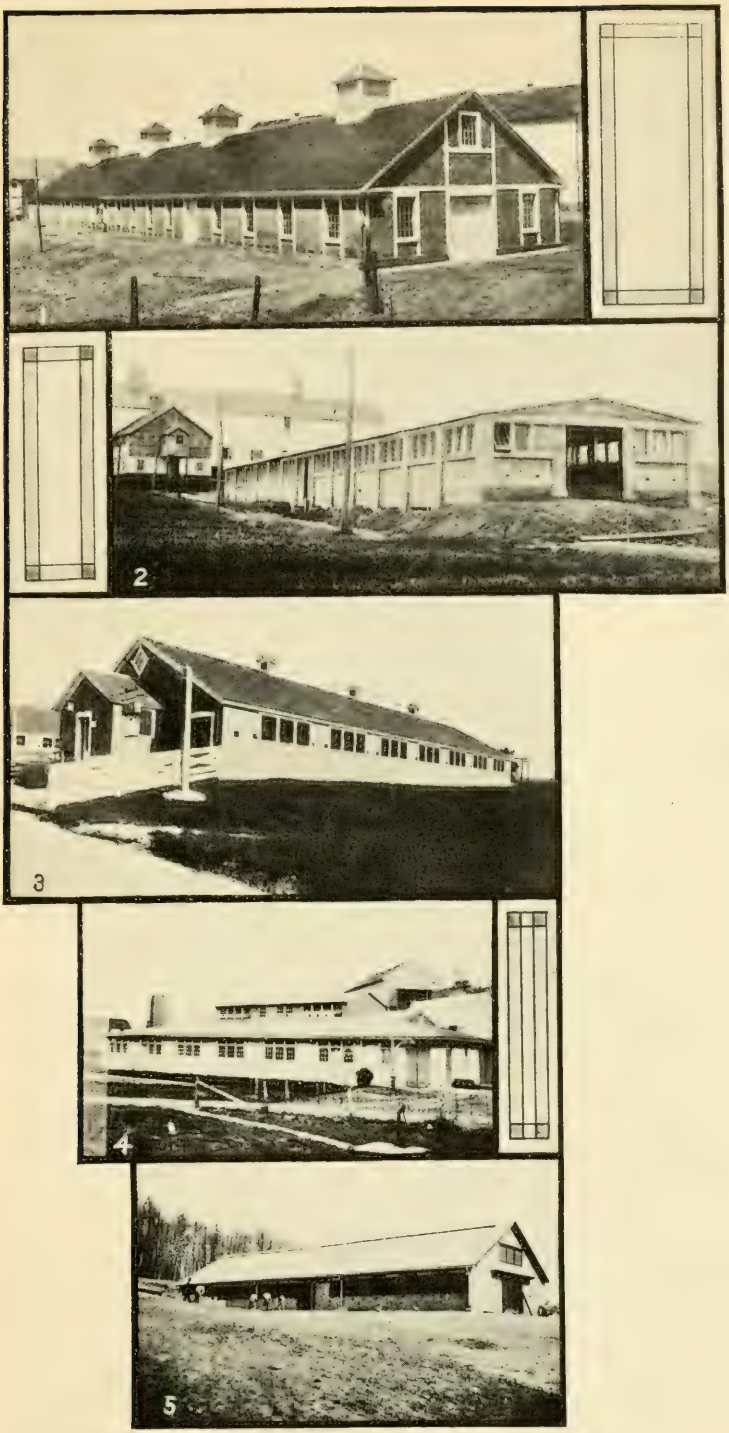
Particular attention is paid by certified dairies to the construction of the utensils which come in contact with the milk. It is most desirable to have the utensils as free as possible from all crevices and inaccessible parts. The simplest utensils are the ones which are the most readily cleaned, and hence the danger of contamination from them is less. Small-top milk pails are used by practically every certified dairy. There are many forms of the small-top milk pail in use at the present time, and it is generally known that these pails are responsible for the elimination of many bacteria from milk. Figure 1 shows a small-top pail which can be made from an ordinary milk pail by the addition of a hood. This pail will take the place of some of the more expensive kinds and do very satisfactory work.

In considering the purchase of a sanitary milk pail two things must be considered—first, its practicability, and, second, the ease with which it can be cleaned. Some of the so-called sanitary pails have proved to be too cumbersome and unwieldy for practical use, while others have spouts, sharp angles, and inaccessible places that are extremely difficult to clean. It is usually the practice to fill all of the seams and corners in milk utensils with solder, so that a smooth, cleanable surface is presented.

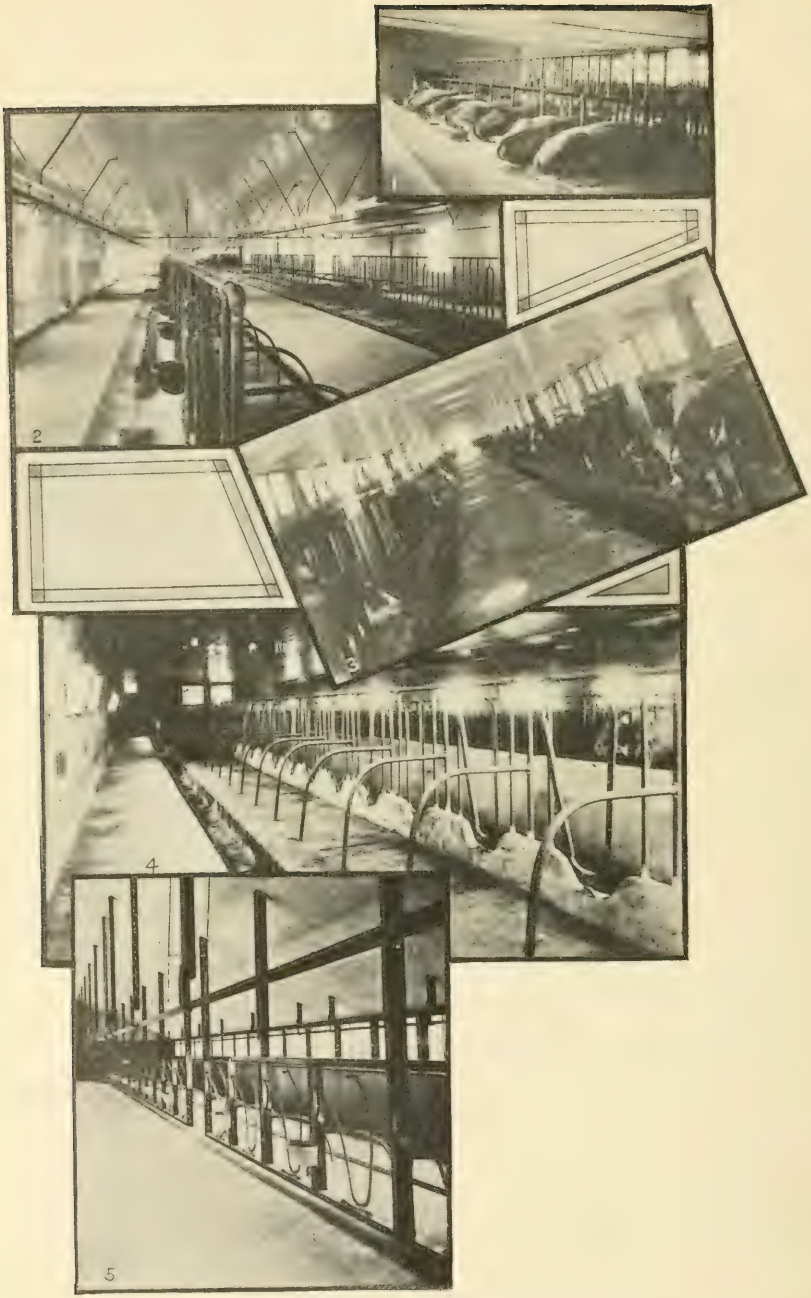
At practically all of the certified dairies steam is used for the sterilization of utensils, including bottles, cans, milk pails, strainers, and in some cases even the coolers and bottle fillers. This sterilization is done in large ovens, which can be bought ready-made or can be built by the owner of the plant. (See Pl. IV, fig. 12.) In these sterilizers the utensils are sterilized with live steam, usually for a half hour and sometimes under a slight pressure. These sterilizers are constructed of cement, brick, iron, and in one dairy the sterilizer in use is lined with glass enamel, which makes a smooth, cleanable surface. In many certified dairies the custom is practiced of sterilizing the milk pails and other utensils and leaving them inverted in the sterilizer until milking time. This protects them from contamination due to flies or impure outside air.

PREPARATION FOR MILKING.

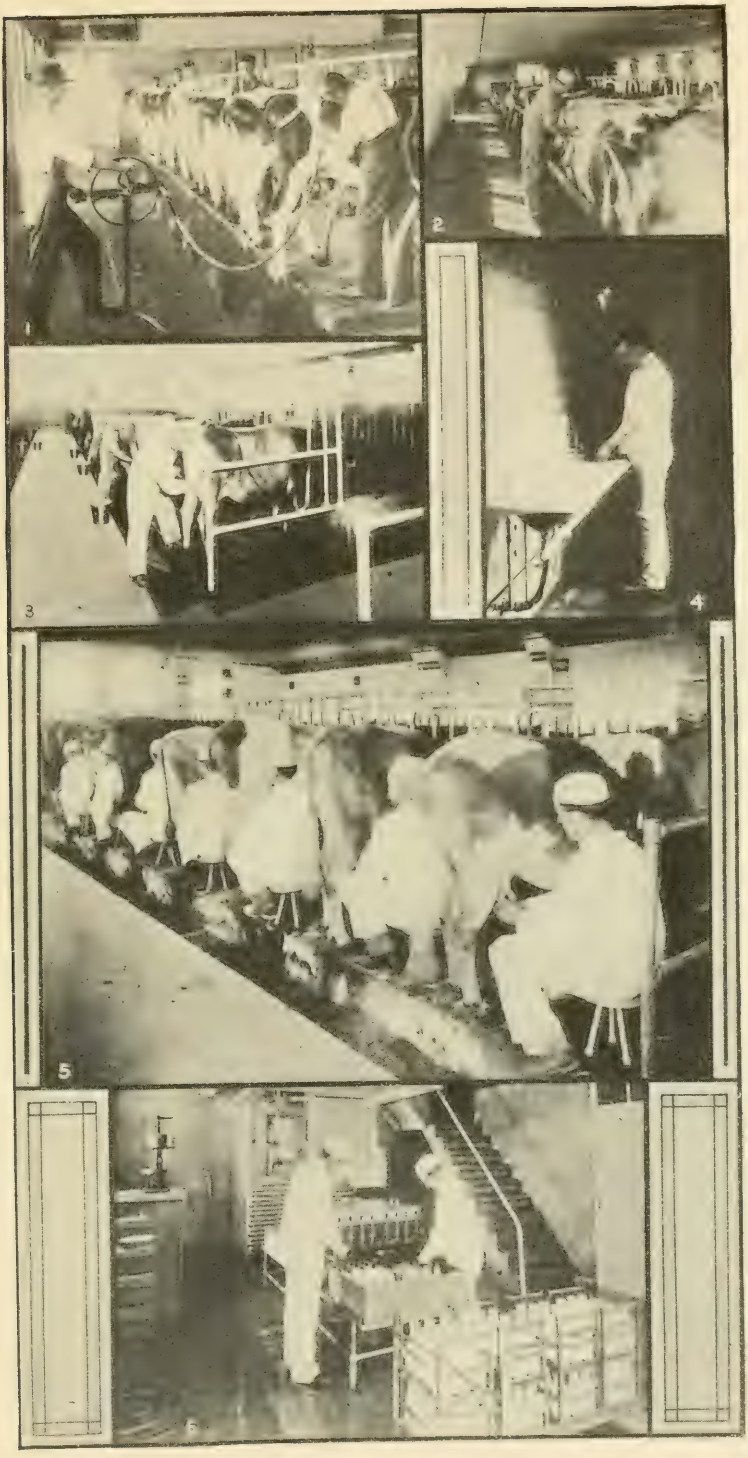
At all certified dairies great care is exercised to see that the stable air is free from dust and odors at milking time. The cows are groomed and the floors are swept long enough before milking so that the dust has had a chance to settle. Some dairies make a practice of spraying the air in the barn and the bedding with a fine spray of water just previous to milking, so that all dust particles are laid. At one dairy this result is achieved by the use of steam. Pipes pierced with holes run horizontally through the barn, and just before milking steam is turned into them. One disadvantage of this method is that it raises the temperature in the barn considerably in the summer time. Before milking, the cows are usually cleaned by a separate gang of men. In a few places the milkers wash the cows just before they milk them, but this is not considered so satisfactory on account of the fact that the milkers' hands are apt to be contaminated from the wash water, and unless they are careful to clean them each time there may be bad results. The cow-cleaning gang usually consists of three or four men, who thoroughly prepare the cows for the milkers. One of these men sometimes uses a damp towel or a piece of sacking with which he wipes off the body of the cow to remove any loose hairs or dust which have not been removed by previous grooming. Then the cow's udder and flanks are washed, usually in two separate waters, care being taken to change the water often enough so that it does



EXTERIOR VIEWS OF DAIRY STABLES WHERE CERTIFIED MILK IS PRODUCED.



INTERIOR VIEWS OF DAIRY STABLES WHERE CERTIFIED MILK IS PRODUCED.



STEPS IN THE PRODUCTION AND HANDLING OF CERTIFIED MILK.

1. Clipping cows. 2. Cleaning cows. 3. Washing cows preparatory to milking. 4. Milker washing hands. 5. Milking. 6. Cooling and bottling.

STEPS IN THE HANDLING AND DELIVERY OF CERTIFIED MILK.

7. Sealing bottles. 8. Storage. 9. Case of bottles ready for delivery. 10. Delivery wagon. 11. Washing bottles. 12. Sterilizing bottles.

OUTSIDE COVERINGS USED TO PROTECT BOTTLE MOUTHS FROM CONTAMINATION.

not do more harm than good. In some certified dairies a disinfectant is used in this water, but in the majority of cases plain water is used. After washing, the cows are usually partially dried with a clean towel, the object being to have the cows' hides slightly moist, but not wet enough for any moisture to run on the milkers' hands or drip into the pail.

While the cows are being prepared the milkers assemble in the dressing room and put on their clean milking suits and thoroughly scrub their hands and finger nails with soap and brushes. In a few dairies the requirements for the cleanliness of the milkers are so rigid that only smooth-shaven men are allowed to milk the cows or have anything to do with handling the milk. When the milkers are satisfactorily prepared for milking they are handed sterilized milk pails and milking stools and allowed to start work. In some dairies the cows are milked in a room separate from the stable. This room holds only a few cows at a time, the cows being cleaned in the main barn and led into the milking room to be milked. Judging from the bacterial counts of the various dairies there is nothing specially gained by this, if proper precautions are taken in the main barn.

MILKING.

In a few dairies the milkers use a little vaseline on the hands while milking, but in practically all cases milking is done with dry hands. It is very often the practice to discard the first few streams of milk from each cow, which are drawn into a cup. This "foremilk" contains large numbers of bacteria, and the count can be reduced by rejecting it.

Milkers are instructed to milk quickly and quietly, and after each cow is finished they carry the milk to the straining room, where it is strained and cooled immediately. By far the best method is to require the milkers to wash their hands after milking each cow. Plenty of clean towels should be provided for the purpose of wiping the milkers' hands. In one dairy paper towels are being used, so that perfectly fresh unused towels are at hand for each milker. During the milking the milkers should not be allowed to rest the milk pail on the floor, as the bottom of the pail is liable to become covered with dirt, which is transferred to the milkers' hands when he pours the milk from the pail.

SUBSEQUENT HANDLING OF MILK.

The milk is removed immediately from the barn to the milk house, where it is cooled and bottled at once. In some dairies the milk is bottled warm and the bottles are packed in ice or stood in ice water. This eliminates much exposure to the air. Various types of bottle fillers are in use in the large dairies, while one or two of

the very smallest fill the bottles from a large dipper or pitcher. In the last few years capping machines have been perfected so that the bottles may be filled and capped without being touched by human hands. This is a decided advantage, as the old method of placing the caps in the bottles by hand was liable to result in serious contamination. Practically all of the certified establishments sterilize the caps which are used in the milk bottles. This sterilization is best accomplished by dry heat, as steam is apt to swell the paper caps so that they do not fit the capping machine or the neck of the bottle. The caps are placed in a small cylinder or rolled in brown paper and placed in dry ovens, where they are heated for about an hour.

Practically all certified-milk dairies now use some sort of an outside cover to protect the mouth of the bottle from being infected with dust or dirty water. A variety of appliances for this purpose are in use, some of which are shown in Plate V.

TRANSPORTATION AND DELIVERY.

Great care is taken to see that certified milk is always kept cold. It is cooled in the dairies by ice water, brine, or direct expansion almost down to the freezing point, and from that time until it is delivered to the consumer it is kept well packed in ice to prevent the multiplication of bacteria.

The distribution of certified milk is done in some cases by the producer, but very often the producer ships to some retailer in the city, who handles the product for him.

Some certified dairies maintain laboratories in charge of physicians or trained nurses where certified milk is modified for infant feeding according to physicians' prescriptions. The modified milk is put up in nursing bottles, sufficient feedings for one day being prepared at a time and delivered to the consumer in a refrigerator case.

INFORMATION SECURED FROM PRODUCERS.

In order to secure accurate data relative to the production of certified milk, a list of questions was sent to owners and operators of certified-milk farms. Answers were received from a large number. It was found that quite a number had discontinued the production of certified milk for one reason or another, several having stopped because of the lack of sufficient markets for their product or because the production was attended with financial loss. Answers to the questions were received from 92 dairies, distributed among 17 States.

NUMBER AND BREED OF COWS.

The number of cows in herds producing certified milk varies from 9 to 600. It was found that the average number of cows in certified dairies was 88. Practically every breed is represented in these herds.

Some grade or native stock is found in most of them. There are several herds of registered animals. The breed is not considered of special importance with most of the commissions, provided that the composition of the milk produced is within the limits of the standards prescribed. Provided that the health of the animals is perfect, it makes very little difference apparently what the breed is.

QUANTITY AND QUALITY OF THE MILK.

The amount of certified milk produced daily by certified dairies ranged from 12½ to 6,000 quarts. The average daily production per dairy was found to be 747½ quarts. The average production of all the cows of all the dairies reporting is somewhat higher than that found in market milk dairies, but it is still far too low. An average of all the answers received showed that the production amounted to 8.3 quarts of milk per cow per day. The fat in the milk as reported varies from 3.2 to 6 per cent, and averages about 4.3 per cent. This is a slightly lower average than was found in the investigations made in 1907. The total solids as reported by the various dairies ranged from 11.74 to 14.5 per cent, with an average for all dairies of an even 13 per cent.

BACTERIA IN THE MILK.

The average bacterial counts of the milk from the dairies reporting varied considerably. One dairy claimed that their count ranges from absolutely sterile plates up to 1,000 bacteria per cubic centimeter. Three dairies reported counts of 20,000. The average bacterial count of all the dairies reporting was 4,069 per cubic centimeter. Some extremely low averages were reported, one dairy having an average count for one year of 655 bacteria per cubic centimeter. Still another dairy reported a seven weeks' average of 600 bacteria per cubic centimeter.

RETAIL PRICES OF CERTIFIED MILK.

The producers' reports on the retail price of their product shows that the lowest price received is 10 cents a quart, which price was reported by four dairies. The highest retail price was 20 cents a quart, which is received by two dairies. Averaging all the replies, it was found that the average retail price of certified milk is 14.3 cents a quart.

AGE OF MILK WHEN DELIVERED.

Milk commissions have striven for the delivery of certified milk as soon after it is produced as possible; all other things being equal, the sooner it is delivered and consumed the better. In answer to the question as to the average age of certified milk when delivered, 92 producers returned answers which showed that some milk was

delivered within 6 hours after its production, while some was not placed on the market until it was 48 hours old. The average age when delivered was 20 hours. As some of this milk will not be used until 24 hours after its delivery, it is possible for some certified milk to be consumed after it is 72 hours old.

SANITARY CONDITION OF CERTIFIED-MILK DAIRIES.

In the past about 37 certified farms have been scored by representatives of the Dairy Division. An average of all these scores shows that the condition of certified-milk farms is about 90 points out of a possible 100. This is a remarkably good showing, in view of the fact that to attain a mark of 100 conditions must be absolutely perfect in every respect; that is, that not a speck of dust or dirt could be found on the cattle or in the stables or milk house and that everything else was above criticism in every respect. That certified dairies have maintained a high standard is evidenced by the comparison of their standing with the scores of ordinary dairies in general. Dairies supplying market milk to various cities in this country have been scored and will average between 40 and 45, depending upon the section of the country and the efficiency of the inspection system which governs them. A total of 953 dairies, the scores of which were filed in this division in one year, show an average score of 41.6 out of a possible 100; so that it will be seen that the average certified dairy scores more than twice as high as the average market-milk dairy. The lowest score of a certified-milk dairy of which there is any record in this department is 73.6.

QUALITY OF CERTIFIED MILK.

An index to the quality of certified milk is the result of complete analyses and examinations of this product at various milk contests, descriptions of which will be found in Bureau of Animal Industry Circular 205. Eighty-nine samples of certified milk and cream were scored in these contests, and the average score was 87.96 for certified milk and 87.82 for certified cream. The greatest fault in these samples was that relating to flavor and odor rather than to the bacterial count. When it is realized that in order to score perfect on bacterial count in these contests the average number of organisms found must be less than 400 to the cubic centimeter, it will readily be seen that certified milk has maintained a high standard as regards quality. Certified milk and cream both scored considerably higher than did milk and cream in the market classes. The average bacterial count for all the samples of certified milk submitted in these contests was between 7,000 and 8,000 to the cubic centimeter. It must be remembered that many of these samples were prepared especially for the

contests, so that they indicate a knowledge of dairy sanitation and do not necessarily mean a uniform product of the same high quality.

KEEPING QUALITIES OF CERTIFIED MILK.

As would naturally be expected, certified milk with its small number of bacteria will keep sweet for a long time. The theory that clean milk should have a long keeping quality works out in practice. Instances are on record where certified milk has been taken on an ocean voyage and not only brought back in good condition but kept sweet until 30 days old. In fact, it is now a common practice for people when crossing the water or taking a long land journey with infants to take several cases of certified milk with them. They are then reasonably sure of having a constant supply of sweet milk for several days. This has been a great convenience and has given comfort to many people.

A number of certified-milk dairies in the United States sent exhibits of milk to the Paris Exposition in 1900. The milk kept perfectly sweet for two weeks and in some instances 18 days after being bottled and after a summer journey of 3,000 to 4,000 miles. Regular delivery bottles were used, the only extra precaution being to use two paper caps instead of one, and to cover the caps with paraffin so as to exclude the air. Of course the milk was carefully packed in ice for shipment, but this was the only means used for preservation.

The milk and cream contests at the National Dairy Show in recent years have demonstrated the remarkable keeping qualities of certified milk. Some of the samples submitted have come to Chicago from as far as the States of Washington and California, and from various parts of Canada. Though these samples have some of them been over a week old when plated, they have shown remarkably low bacterial counts, in some instances the count being less than 1,000 per cubic centimeter. After this milk has been judged it has been kept in cold storage, and some has been consumed over two weeks after its production, when it was found perfectly palatable and apparently unchanged in any way.

However, it is not advisable to use old milk even though it may taste sweet. Serious consequences may result due to bacterial growth which can not be detected in the flavor of the milk.

IS THE PRODUCTION OF CERTIFIED MILK PROFITABLE?

At the present time the unqualified statement can not be made that the production of certified milk is a profitable venture. Seventy-four certified-milk producers answered the questions sent out by the Dairy Division as to the profitableness of certified-milk production, and their answers may be grouped as follows: Unprofitable, 33; profitable, 22; not very profitable, 4; fairly profitable, 11; condi-

tional answers, 4. The conditional answers included 3 which stated that the business was profitable only part of the time, and 1 which stated that it would be profitable if the markets for the product were larger. These answers can not be considered as favorable to the profitable production of certified milk, so a regrouping would give: Profitable, 37; unprofitable, 37.

Out of the 37 dairies which are classed as profitable there are 15 which state that the business is not very profitable or only fairly so. There is very little doubt that certified milk can be produced and sold at a fair profit, as this is being done by many dairies at the present time. However, the large number of unprofitable dairies shows that there is need for a radical change in the methods of many of the farms which are producing this class of milk. It is unquestionably the fact that many certified-milk producers can lower the price of production by applying better business principles to their operations, and this will undoubtedly result in a swinging of the balance from loss to profit on their books.

OBSTACLES TO THE PROFITABLE PRODUCTION OF CERTIFIED MILK.

To support the statement that some certified dairies are run under lax business methods, it is only necessary to point to a few figures received by this department. For instance, one dairy reports that the retail price of milk is 20 cents a quart, the average bacterial count is 4,000 per cubic centimeter, and that the business is not profitable and it would require a retail price of 25 cents a quart to make it so. Another dairy states that the retail price is only 12 cents, the bacterial count 3,000 (less than in the case of the other dairy), and that the business is profitable. There is a difference of 8 cents a quart in favor of the first dairy, and yet with that advantage it is unable to conduct the business at a profit.

Many certified-milk producers have erected extremely elaborate buildings, the interest and depreciation on which are so high that they form a considerable item to be charged against the cost of production. The interest and depreciation on a simple, inexpensive certified plant is estimated to amount to at least 6 cents a gallon, or 1½ cents a quart. In some of the more elaborate plants, where much money has been spent for ornamental equipment, the interest and depreciation would be much higher. Experience in the past has proved that the production of clean milk is not dependent upon expensive equipment so much as upon care and vigilance concerning the methods of production. It is a well-known fact in business that a manufacturing plant can not afford to turn out such a small quantity of goods that the interest and depreciation on the factory will be too heavy a tax on the goods sold. Applying this same principle to dairying, it is almost impossible to see where some of the small dairies can afford to operate

as they do. One dairy reports that they are selling only 12½ quarts of certified milk a day, and the interest and depreciation on the capital invested in this plant will certainly amount to quite a large item per quart on all the milk sold. Another plant reports a daily selling of 30 quarts, and another of only 120 quarts.

The average production of milk per cow in certified dairies shows that many unprofitable animals are probably being kept, and a thorough system of record keeping should be inaugurated in order to weed out the low producers. One dairy reports that the average test of the milk is 6 per cent fat, and it is hard to see how such milk can be profitably sold in competition with 4 per cent milk. In order to improve the herds from year to year calves should be raised from the best producing cows. Here again is another item of added expense on the certified dairy, as the raising of calves is an expensive proposition, especially where milk valued at from 15 to 20 cents a quart is used. If calves are not raised and cows are bought from the outside there is little chance of bettering the herd.

On most certified farms a higher class of labor is utilized than on the ordinary dairy farm. Many college graduates are employed as foremen, managers, or bacteriologists, and such men usually command higher salaries.

Markets for certified milk at the present time are not developed sufficiently. Several of the certified dairies reporting that the production of this product was unprofitable intimated that if more milk could be sold and the plant operated at a greater capacity a profit might be realized. The general public so far has very little idea as to what certified milk really is, and an educational campaign might well be carried on by the producers. In addition to this, lax methods on some farms have necessitated a high price for certified milk, and this has cut down the consumption considerably.

There seems to be little uniformity regarding the distribution of certified milk. Some of the methods now in vogue seem to be to the disadvantage of the producer. Of the producers reporting, 25 retail the product of their dairies, while 47 do not. From the answers received it appears to be more economical to distribute through a middleman, especially where the points of production and distribution are widely separated. The middleman has the advantage of already maintaining an establishment in the city and of running regular retail routes on which the certified milk can be distributed quite economically. Some of these distributers of certified milk seem to charge the producer a rather high rate for their services. Many city dealers buy market milk from farmers and receive from 14 to 19 cents a gallon to cover the cost of freight, bottling, and distribution, besides giving them their profit. Certified milk is nearly always bottled at the farm, so that the expense of handling in the city is much smaller.

Figures submitted to this department, however, show out of 50 cents a gallon paid by consumers for certified milk from one farm, the producer got 26 cents, the freight was 4 cents, and the middleman charged 20 cents a gallon for his services in distributing the product. Another dairy receives 12 cents out of a retail price of 15 cents a quart, leaving the distributer 12 cents a gallon. In one case the middleman received 5 cents a quart for distribution, while the other received 3 cents.

THE FUTURE OF CERTIFIED MILK.

There is no doubt that from a sanitary standpoint certified milk is constantly improving, and it will undoubtedly continue to lead all classes of milk as a food for infants. It seems almost imperative, however, that business principles be more closely applied to the production of certified milk, so that the price may be kept as low as possible to the consumer and still let the farmers operate at a profit. Upon this one factor depends much of the future growth of the movement. It is very probable that certified-milk producers in the future will apply the same degree of intelligence and care to the economic features of their business as they have in the past to the sanitary side.

THE CERTIFIED MILK PRODUCERS' ASSOCIATION.

In order to disseminate information among themselves concerning methods employed in the production of certified milk, producers of this class of dairy products have formed an organization under the name of The Certified Milk Producers' Association of America. Yearly meetings are held at which papers are read which deal with the production of certified milk, both from a financial standpoint and concerning sanitation.

APPENDIX.

METHODS AND STANDARDS FOR THE PRODUCTION AND DISTRIBUTION OF CERTIFIED MILK.

(Adopted by the American Association of Medical Milk Commissions, May 1, 1912.)

HYGIENE OF THE DAIRY.

UNDER THE SUPERVISION AND CONTROL OF THE VETERINARIAN.

1. *Pastures or paddocks.*—Pastures or paddocks to which the cows have access shall be free from marshes or stagnant pools, crossed by no stream which might become dangerously contaminated, at sufficient distances from offensive conditions to suffer no bad effects from them, and shall be free from plants which affect the milk deleteriously.

2. *Surroundings of buildings.*—The surroundings of all buildings shall be kept clean and free from accumulations of dirt, rubbish, decayed vegetable or animal matter or animal waste, and the stable yard shall be well drained.

3. *Location of buildings.*—Buildings in which certified milk is produced and handled shall be so located as to insure proper shelter and good drainage, and at sufficient distance from other buildings, dusty roads, cultivated and dusty fields, and all other possible sources of contamination; provided, in the case of unavoidable proximity to dusty roads or fields, the exposed side shall be screened with cheesecloth.

4. *Construction of stables.*—The stables shall be constructed so as to facilitate the prompt and easy removal of waste products. The floors and platforms shall be made of cement or other nonabsorbent material and the gutters of cement only. The floors shall be properly graded and drained, and the manure gutters shall be from 6 to 8 inches deep and so placed in relation to the platform that all manure will drop into them.

5. The inside surface of the walls and all interior construction shall be smooth, with tight joints, and shall be capable of shedding water. The ceiling shall be of smooth material and dust tight. All horizontal and slanting surfaces which might harbor dust shall be avoided.

6. *Drinking and feed troughs.*—Drinking troughs or basins shall be drained and cleaned each day, and feed troughs and mixing floors shall be kept in a clean and sanitary condition.

7. *Stanchions.*—Stanchions, when used, shall be constructed of iron pipes or hardwood, and throat latches shall be provided to prevent the cows from lying down between the time of cleaning and the time of milking.

8. *Ventilation.*—The cow stables shall be provided with adequate ventilation either by means of some approved artificial device, or by the substitution of cheesecloth for glass in the windows, each cow to be provided with a minimum of 600 cubic feet of air space.

9. *Windows.*—A sufficient number of windows shall be installed and so distributed as to provide satisfactory light and a maximum of sunshine, 2 feet

square of window area to each 600 cubic feet of air space to represent the minimum. The coverings of such windows shall be kept free from dust and dirt.

10. *Exclusion of flies, etc.*—All necessary measures should be taken to prevent the entrance of flies and other insects and rats and other vermin into all the buildings.

11. *Exclusion of animals from the herd.*—No horses, hogs, dogs, or other animals or fowls shall be allowed to come in contact with the certified herd, either in the stables or elsewhere.

12. *Bedding.*—No dusty or moldy hay or straw, bedding from horse stalls, or other unclean materials shall be used for bedding the cows. Only bedding which is clean, dry, and absorbent may be used, preferably shavings or straw.

13. *Cleaning stable and disposal of manure.*—Soiled bedding and manure shall be removed at least twice daily, and the floors shall be swept and kept free from refuse. Such cleaning shall be done at least one hour before the milking time. Manure, when removed, shall be drawn to the field or temporarily stored in containers so screened as to exclude flies. Manure shall not be even temporarily stored within 300 feet of the barn or dairy building.

14. *Cleaning of cows.* Each cow in the herd shall be groomed daily, and no manure, mud, or filth shall be allowed to remain upon her during milking; for cleaning, a vacuum apparatus is recommended.

15. *Clipping.*—Long hairs shall be clipped from the udder and flanks of the cow and from the tail above the brush. The hair on the tail shall be cut so that the brush may be well above the ground.

16. *Cleaning of udders.*—The udders and teats of the cow shall be cleaned before milking; they shall be washed with a cloth and water, and dry wiped with another clean sterilized cloth—a separate cloth for drying each cow.

17. *Feeding.*—All foodstuffs shall be kept in an apartment separate from and not directly communicating with the cow barn. They shall be brought into the barn only immediately before the feeding hour, which shall follow the milking.

18. Only those foods shall be used which consist of fresh, palatable, or nutritious materials, such as will not injure the health of the cows or unfavorably affect the taste or character of the milk. Any dirty or moldy food or food in a state of decomposition or putrefaction shall not be given.

19. A well-balanced ration shall be used, and all changes of food shall be made slowly. The first few feedings of grass, alfalfa, ensilage, green corn, or other green feeds shall be given in small rations and increased gradually to full ration.

20. *Exercise.*—All dairy cows shall be turned out for exercise at least 2 hours in each 24 in suitable weather. Exercise yards shall be kept free from manure and other filth.

21. *Washing of hands.*—Conveniently located facilities shall be provided for the milkers to wash in before and during milking.

22. The hands of the milkers shall be thoroughly washed with soap, water, and brush and carefully dried on a clean towel immediately before milking. The hands of the milkers shall be rinsed with clean water and carefully dried before milking each cow. The practice of moistening the hands with milk is forbidden.

23. *Milking clothes.*—Clean overalls, jumper, and cap shall be worn during milking. They shall be washed or sterilized each day and used for no other purpose, and when not in use they shall be kept in a clean place, protected from dust and dirt.

24. *Things to be avoided by milkers.*—While engaged about the dairy or in handling the milk employees shall not use tobacco nor intoxicating liquors.

They shall keep their fingers away from their nose and mouth, and no milker shall permit his hands, fingers, lips, or tongue to come in contact with milk intended for sale.

25. During milking the milkers shall be careful not to touch anything but the clean top of the milking stool, the milk pail, and the cow's teats.

26. Milkers are forbidden to spit upon the walls or floors of stables, or upon the walls or floors of milk houses, or into the water used for cooling the milk or washing the utensils.

27. *Fore milk.*—The first streams from each teat shall be rejected, as this fore milk contains large numbers of bacteria. Such milk shall be collected into a separate vessel and not milked onto the floors or into the gutters. The milking shall be done rapidly and quietly, and the cows shall be treated kindly.

28. *Milk and calving period.*—Milk from all cows shall be excluded for a period of 45 days before and 7 days after parturition.

29. *Bloody and stringy milk.*—If milk from any cow is bloody and stringy or of unnatural appearance, the milk from that cow shall be rejected and the cow isolated from the herd until the cause of such abnormal appearance has been determined and removed, special attention being given in the meantime to the feeding or to possible injuries. If dirt gets into the pail, the milk shall be discarded and the pail washed before it is used.

30. *Make-up of herd.*—No cows except those receiving the same supervision and care as the certified herd shall be kept in the same barn or brought in contact with them.

31. *Employees other than milkers.*—The requirements for milkers, relative to garments and cleaning of hands, shall apply to all other persons handling the milk, and children unattended by adults shall not be allowed in the dairy nor in the stable during milking.

32. *Straining and strainers.*—Promptly after the milk is drawn it shall be removed from the stable to a clean room and then emptied from the milk pail to the can, being strained through strainers made of a double layer of finely meshed cheesecloth or absorbent cotton thoroughly sterilized. Several strainers shall be provided for each milking in order that they may be frequently changed.

33. *Dairy building.*—A dairy building shall be provided which shall be located at a distance from the stable and dwelling prescribed by the local commission, and there shall be no hogpen, privy, or manure pile at a higher level or within 300 feet of it.

34. The dairy building shall be kept clean and shall not be used for purposes other than the handling and storing of milk and milk utensils. It shall be provided with light and ventilation, and the floors shall be graded and water-tight.

35. The dairy building shall be well lighted and screened and drained through well-trapped pipes. No animals shall be allowed therein. No part of the dairy building shall be used for dwelling or lodging purposes, and the bottling room shall be used for no other purpose than to provide a place for clean milk utensils and for handling the milk. During bottling this room shall be entered only by persons employed therein. The bottling room shall be kept scrupulously clean and free from odors.

36. *Temperature of milk.*—Proper cooling to reduce the temperature to 45° F. shall be used, and aerators shall be so situated that they can be protected from flies, dust, and odors. The milk shall be cooled immediately after being milked, and maintained at a temperature between 35° and 45° F. until delivered to the consumer.

37. *Sealing of bottles.*—Milk, after being cooled and bottled, shall be immediately sealed in a manner satisfactory to the commission, but such seal shall include a sterile hood which completely covers the lip of the bottle.

38. *Cleaning and sterilizing of bottles.*—The dairy building shall be provided with approved apparatus for the cleansing and sterilizing of all bottles and utensils used in milk production. All bottles and utensils shall be thoroughly cleaned by hot water and sal soda, or equally pure agent, rinsed until the cleaning water is thoroughly removed, then exposed to live steam or boiling water at least 20 minutes, and then kept inverted until used, in a place free from dust and other contaminating materials.

39. *Utensils.*—All utensils shall be so constructed as to be easily cleaned. The milk pail should preferably have an elliptical opening 5 by 7 inches in diameter. The cover of this pail should be so convex as to make the entire interior of the pail visible and accessible for cleaning. The pail shall be made of heavy seamless tin, and with seams which are flushed and made smooth by solder. Wooden pails, galvanized-iron pails, or pails made of rough, porous materials, are forbidden. All utensils used in milking shall be kept in good repair.

40. *Water supply.*—The entire water supply shall be absolutely free from contamination, and shall be sufficient for all dairy purposes. It shall be protected against flood or surface drainage, and shall be conveniently situated in relation to the milk house.

41. *Privies, etc., in relation to water supply.*—Privies, pigpens, manure piles, and all other possible sources of contamination shall be so situated on the farm as to render impossible the contamination of the water supply, and shall be so protected by use of screens and other measures as to prevent their becoming breeding grounds for flies.

42. *Toilet rooms.*—Toilet facilities for the milkers shall be provided and located outside of the stable or milk house. These toilets shall be properly screened, shall be kept clean, and shall be accessible to wash basins, water, nail brush, soap and towels, and the milkers shall be required to wash and dry their hands immediately after leaving the toilet room.

TRANSPORTATION.

43. In transit the milk packages shall be kept free from dust and dirt. The wagon, trays, and crates shall be kept scrupulously clean. No bottles shall be collected from houses in which communicable diseases prevail, unless a separate wagon is used and under conditions prescribed by the department of health and the medical milk commission.

44. All certified milk shall reach the consumer within 30 hours after milking.

VETERINARY SUPERVISION OF THE HERD.

45. *Tuberculin test.*—The herd shall be free from tuberculosis, as shown by the proper application of the tuberculin test. The test shall be applied in accordance with the rules and regulations of the United States Government, and all reactors shall be removed immediately from the farm.[1]

46. No new animals shall be admitted to the herd without first having passed a satisfactory tuberculin test, made in accordance with the rules and regulations mentioned; the tuberculin to be obtained and applied only by the official veterinarian of the commission.

47. Immediately following the application of the tuberculin test to a herd for the purpose of eliminating tuberculous cattle, the cow stable and exercising yards shall be disinfected by the veterinary inspector in accordance with the rules and regulations of the United States Government.

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[1] See Circular of Instructions issued by the Bureau of Animal Industry for making tuberculin tests and for disinfection of premises.

48. A second tuberculin test shall follow each primary test after an interval of six months, and shall be applied in accordance with the rules and regulations mentioned. Thereafter, tuberculin tests shall be reapplied annually, but it is recommended that the retests be applied semiannually.

49. *Identification of cows.*—Each dairy cow in each of the certified herds shall be labeled or tagged with a number or mark which will permanently identify her.

50. *Herd-book record.*—Each cow in the herd shall be registered in a herd book, which register shall be accurately kept so that her entrance and departure from the herd and her tuberculin testing can be identified.

51. A copy of this herd-book record shall be kept in the hands of the veterinarian of the medical milk commission under which the dairy farm is operating, and the veterinarian shall be made responsible for the accuracy of this record.

52. *Dates of tuberculin tests.*—The dates of the annual tuberculin tests shall be definitely arranged by the medical milk commission, and all of the results of such tests shall be recorded by the veterinarian and regularly reported to the secretary of the medical milk commission issuing the certificate.

53. The results of all tuberculin tests shall be kept on file by each medical milk commission, and a copy of all such tests shall be made available to the American Association of Medical Milk Commissions for statistical purposes.

54. The proper designated officers of the American Association of Medical Milk Commissions should receive copies of reports of all of the annual, semiannual, and other official tuberculin tests which are made and keep copies of the same on file and compile them annually for the use of the association.

55. *Disposition of cows sick with diseases other than tuberculosis.*—Cows having rheumatism, leucorrhea, inflammation of the uterus, severe diarrhea, or disease of the udder, or cows that from any other cause may be a menace to the herd shall be removed from the herd and placed in a building separate from that which may be used for the isolation of cows with tuberculosis, unless such building has been properly disinfected since it was last used for this purpose. The milk from such cows shall not be used nor shall the cows be restored to the herd until permission has been given by the veterinary inspector after a careful physical examination.

56. *Notification of veterinary inspector.*—In the event of the occurrence of any of the diseases just described between the visits of the veterinary inspector, or if at any time a number of cows become sick at one time in such a way as to suggest the outbreak of a contagious disease or poisoning, it shall be the duty of the dairyman to withdraw such sickened cattle from the herd, to destroy their milk, and to notify the veterinary inspector by telegraph or telephone immediately.

57. *Emaciated cows.*—Cows that are emaciated from chronic diseases or from any cause that in the opinion of the veterinary inspector may endanger the quality of the milk, shall be removed from the herd.

BACTERIOLOGICAL STANDARDS.

58. *Bacterial counts.*—Certified milk shall contain less than 10,000 bacteria per cubic centimeter when delivered. In case a count exceeding 10,000 bacteria per cubic centimeter is found, daily counts shall be made, and if normal counts are not restored within 10 days the certificate shall be suspended.

59. Bacterial counts shall be made at least once a week.

60. *Collection of samples.*—The samples to be examined shall be obtained from milk as offered for sale and shall be taken by a representative of the milk commission. The samples shall be received in the original packages, in prop-

erly iced containers, and they shall be so kept until examined, so as to limit as far as possible changes in their bacterial content.

61. For the purpose of ascertaining the temperature, a separate original package shall be used, and the temperature taken at the time of collecting the sample, using for the purpose a standardized thermometer graduated in the centigrade scale.

62. *Interval between milking and plating.*—The examinations shall be made as soon after collection of the samples as possible, and in no case shall the interval between milking and plating the samples be longer than 40 hours.

63. *Plating.*—The packages shall be opened with aseptic precautions after the milk has been thoroughly mixed by vigorously reversing and shaking the container 25 times.

64. Two plates at least shall be made for each sample of milk, and there shall also be made a control of each lot of medium and apparatus used at each testing. The plates shall be grown at 37° C. for 48 hours.

65. In making the plates there shall be used agar-agar media containing 1.5 per cent agar and giving a reaction of 1.0 to phenolphthalein.

The following is the method recommended by a committee of the American Public Health Association for the making of the media, modified, however, as to the agar content and reaction to conform to the requirements specified in section 65:

1. Boil 15 grams of thread agar in 500 c. c. of water for half an hour and make up weight to 500 grams or digest for 10 minutes in the autoclave at 110° C. Let this cool to about 60° C.
2. Infuse 500 grams finely chopped lean beef for 24 hours with its own weight of distilled water in the refrigerator.
3. Make up any loss by evaporation.
4. Strain infusion through cotton flannel, using pressure.
5. Weigh filtered infusion.
6. Add Witte's peptone, 2 per cent.
7. Warm on water bath, stirring until peptone is dissolved and not allowing temperature to rise above 60° C.
8. To the 500 grams of meat infusion (with peptone) add 500 grams of the 2 per cent agar, keeping the temperature below 60° C.
9. Heat over boiling water (or steam) bath 30 minutes.
10. Restore weight lost by evaporation.
11. Titrate after boiling one minute to expel carbonic acid.
12. Adjust reaction to final point desired +1 by adding normal sodium hydrate.
13. Boil two minutes over free flame, constantly stirring.
14. Restore weight lost by evaporation.
15. Filter through absorbent cotton or coarse filter paper, passing the filtrate through the filter repeatedly until clear.
16. Titrate and record the final reaction.
17. Tube (10 c. c. to a tube) and sterilize in autoclave one hour at 15 pounds pressure or in the streaming steam for 20 minutes on three successive days.

66. Samples of milk for plating shall be diluted in the proportion of 1 part of milk to 99 parts of sterile water; shake 25 times and plate 1 c. c. of the dilution.

The committee on bacterial milk analyses of the American Public Health Association in Part IV of its report presented details with respect to plating apparatus and technique in part as follows:

Plating apparatus.—For plating it is best to have a water bath in which to melt the media and a water-jacketed water bath for keeping it at the required temperature; a wire rack which should fit both the water baths for holding the media tubes; a thermometer for recording the temperature of the water in the water-jacketed bath, sterile 1 c. c. pipettes, sterile Petri dishes, and sterile dilution water in measured quantities.

Dilutions.—Ordinary potable water, sterilized, may be used for dilutions. Occasionally spore forms are found in such water which resist ordinary auto-

clave sterilization; in such cases distilled water may be used or the autoclave pressure increased. With dilution water in 8-ounce bottles calibrated for 99 cubic centimeters * * * all the necessary dilutions may be made.

Short, wide-mouthed "blakes" or wide-mouthed French square bottles are more easily handled and more economical of space than other forms of bottles or flasks.

Eight-ounce bottles are the best, as the required amount of dilution water only about half fills them, leaving room for shaking. Long-fiber nonabsorbent cotton should be used for plugs. It is well to use care in selecting cotton for this purpose to avoid short-fiber or dusty cotton, which give a cloud of lint-like particles on shaking. Bottles * * * should be filled a little over the 99 c. c. * * * to allow for loss during sterilization.

Pipettes.—Straight sides 1 c. c. pipettes are more easily handled than those with bulbs; they may be made from ordinary three-sixteenths inch glass tubing and should be about 10 inches in length.

Plating technique.—The agar after melting should be kept in the water-jacketed water bath between 40° C. and 45° C. for at least 15 minutes before using to make sure that the agar itself has reached the temperature of the surrounding water. If used too warm the heat may destroy some of the bacteria or retard their growth.

Shake the milk sample 25 times, then with a sterile pipette transfer 1 c. c. to the first dilution water and rinse the pipette by drawing dilution water to the mark and expelling; this gives a dilution 1 to 100.

* * * Then with a sterile pipette transfer 1 c. c. to the Petri dish, using care to raise the cover only as far as necessary to insert the end of the pipette.

Take the tube of agar from the water bath, wipe the water from outside the tube with a piece of cloth, remove the plug, pass the mouth of the tube through a flame, and pour the agar into the plate, using the same care as before to avoid exposure of the plate contents to the air.

Carefully and thoroughly mix the agar and diluted milk in the Petri dish by a rotary motion, avoiding the formation of air bubbles or slopping the agar, and after allowing the agar to harden for at least 15 minutes at room temperature, place the dish bottom down in the incubator.

Plating should always be done in a place free from dust or currents of air.

In order that colonies may have sufficient food for proper development 10 c. c. of agar shall be used for each plate.

67. *Determination of taste and odor of milk.*—After the plates have been prepared and placed in the incubator, the taste and odor of the milk shall be determined after warming the milk to 100° F.[1]

68. *Counts.*—The total number of colonies on each plate should be counted, and the results expressed in multiples of the dilution factor. Colonies too small to be seen with the naked eye or with slight magnification shall not be considered in the count.

69. *Records of bacteriologic tests.*—The results of all bacterial tests shall be kept on file by the secretary of each commission, copies of which should be made available annually for the use of the American Association of Medical Milk Commissions.

CHEMICAL STANDARDS AND METHODS.

The methods that must be followed in carrying out the chemical investigations essential to the protection of certified milk are so complicated that in order to keep the fees of the chemist at a reasonable figure, there must be eliminated from the examination those procedures which, whilst they might be helpful and interesting, are in no sense necessary.

For this reason the determination of the water, the total solids and the milk sugar is not required as a part of the routine examination.

70. The chemical analyses shall be made by a competent chemist designated by the medical milk commission.

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[1] Should it be deemed desirable and necessary to conduct tests for sediment, the presence of special bacteria, or the number of leucocytes, the methods adopted by the committee of the American Public Health Association should be followed.

71. *Method of obtaining samples.*—The samples to be examined by the chemist shall have been examined previously by the bacteriologist designated by the medical milk commission as to temperature, odor, taste, and bacterial content.

72. *Fat standards.*—The fat standard for certified milk shall be 4 per cent, with a permissible range of variation of from 3.5 to 4.5 per cent.

73. The fat standard for certified cream shall be not less than 18 per cent.

74. If it is desired to sell higher fat-percentage milks or creams as certified milks or creams, the range of variation for such milks shall be 0.5 per cent on either side of the advertised percentage and the range of variations for such creams shall be 2 per cent on either side of the advertised percentage.

75. The fat content of certified milks and creams shall be determined at least once each month.

76. The methods recommended for this purpose are the Babcock (*a*), the Leffmann-Beam (*b*), and the Gerber (*c*).

(*a*) *Babcock test.*—The Babcock test is based on the fact that strong sulphuric acid will dissolve the nonfatty solid constituents of milk, and thus enable the fat to separate on standing. It can be conducted by any of the Babcock outfits which are purchasable in the market.

"The test is made by placing in the special test bottle 18 grams (17.6 c. c.) of milk. To this is added, from a pipette, burette, or measuring bottle, 17.5 c. c. commercial sulphuric acid of a specific gravity of 1.82 to 1.83. The contents of the bottle are carefully and thoroughly mixed by a rotary motion. The mixture becomes brown and heat is generated. The test bottle is now placed in a properly balanced centrifuge and whirled for 5 minutes at a speed of from 800 to 1,200 revolutions per minute. Hot water is then added to fill the bottle to the lower part of the neck, after which it is again whirled for two minutes. Now, enough hot water is added to float the column of fat into the graduated portion of the neck of the bottle, and the whirling is repeated for a minute. The amount of fat is read while the neck of the bottle is still hot. The reading is from the upper limits of the meniscus. A pair of calipers is of assistance in measuring the column of fat." (Jensen's Milk Hygiene, Leonard Pearson's translation.)

(*b*) *Leffmann-Beam test.*—The distinctive feature is the use of fusel oil, the effect of which is to produce a greater difference in surface tension between the fat and the liquid in which it is suspended, and thus promote its readier separation. This effect has been found to be heightened by the presence of a small amount of hydrochloric acid.

The test bottles have a capacity of about 30 c. c. and are provided with a graduated neck, each division of which represents 0.1 per cent by weight of butter fat.

Fifteen centimeters of the milk are measured into the bottle, 3 c. c. of a mixture of equal parts of amyl alcohol and strong hydrochloric acid added and mixed. Then 9 c. c. of concentrated sulphuric acid is added in portions of about 1 c. c.; after each addition the liquids are mixed by giving the bottle a gyratory motion. If the fluid has not lost all of its milky color by this treatment, a little more concentrated acid must be added. The neck of the bottle is now immediately filled at about the zero point with one part sulphuric acid and two parts water, well mixed just before using. Both the liquid in the bottle and the diluted acid must be hot. The bottle is then placed at once in the centrifugal machine; after rotation from one to two minutes, the fat will collect in the neck of the bottle and the percentage may be read off.

(*c*) *Gerber's test.*—This test is applied as follows: The test bottles are put into the stand with the mouths uppermost; then, with the pipette designed for the purpose, or with an automatic measurer, 10 c. c. of sulphuric acid are filled into the test bottle, care being taken not to allow any to come in contact with the neck. The few drops remaining in the tip of the pipette should not be blown out. Then 11 c. c. of milk are measured with the proper pipette and allowed to flow slowly onto the acid, so that the two liquids mix as little as possible. Finally, the amyl alcohol is added. (It is important to use the reagents in the proper order, which is—sulphuric acid, milk, amyl alcohol. If the sulphuric acid is followed by amyl alcohol and the milk last, then the result is sometimes incorrect.) A rubber stopper, which must not be damaged, is then fitted into the mouth of the test bottle, and the contents are well shaken,

the thumb being kept on the stopper to prevent it coming out. As a considerable amount of heat is generated by the action of the sulphuric acid on the milk, the test bottle should be wrapped in a cloth.

The shaking of the sample must be done thoroughly and quickly, and the test bottle inverted several times, so that the liquid in the neck becomes thoroughly mixed. By pressing in the rubber stopper the height of the liquid can be brought to about the zero point on the scale.

If only a few samples have to be analyzed and the room is warm, the test botttles can be put into the centrifuge without any preliminary heating, otherwise the test bottles must be warmed for a few minutes (not longer) in the water bath at a temperature of 60° to 65° C. When the temperature rises higher than this, say above 70° C., the rubber stopper is liable to be blown out of the test bottle. After the test bottles have been heated they are arranged symmetrically in the centrifuge and whirled for 3 to 4 minutes at a speed of about 1,000 revolutions per minute. When the centrifuge has a heating arrangement attached to it, the preliminary warming is not, of course, necessary. When the test bottles are taken out of the centrifuge, they are again placed in the water bath at a temperature of 60° to 65° C., and left there for several minutes before being read; where the centrifuge is heated, the tubes can be read off as taken from the centrifuge.

By carefully screwing in the rubber stopper, or even by pressing it, the lower limit of the fat column is brought onto one of the main divisions of the scale, and then, by holding the test bottle against the light, the height of the column of fat can be accurately ascertained. The lowest point of the meniscus is taken as the level when reading the upper surface of the fat in a sample of whole milk, and the middle of the meniscus for separated milk.

If the column of fat is not clear and sharply defined, the sample must be again whirled in the centrifuge.

Each division on the scale is equivalent to 0.1 per cent, so it is very easy to read to 0.05 per cent, or, with a lens, to 0.025 per cent. If the number which is read off is multiplied by 0.1, then the percentage quantity of fat in the milk is obtained; e. g., if the number on the scale was 36.5, then the percentage of fat is 3.65. (Milk and Dairy Products, Barthel; translated by Goodwin, p. 71.)

77. Before condemning samples of milk which have fallen outside the limits allowed, the chemist shall have determined, by control ether extractions, that his apparatus and his technique are reliable.

78. *Protein standard.*—The protein standard for certified milk shall be 3.50 per cent, with a permissible range of variation of from 3 to 4 per cent.

79. The protein standard for certified cream shall correspond to the protein standard for certified milk.

80. The protein content shall be determined only when any special consideration seems to the medical milk commission to make it desirable.

81. It shall be determined by the Kjeldahl method, using the Gunning or some other reliable modification, and employing the factor 6.25 in reckoning the protein from the nitrogen.

Kjeldahl method.—Five cubic centimeters of milk are measured carefully into a flat-bottom 800 c. c. Jena flask, 20 c. c. of concentrated sulphuric acid (C. P.; sp. gr., 1.84) are added, and 0.7 gram of mercuric oxid (or its equivalent in metallic mercury); the mixture is then heated over direct flame until it is straw-colored or perfectly white; a few crystals of potassium permanganate are now added till the color of the liquid remains green. All the nitrogen in the milk has then been converted into the form of ammonium sulphate. After cooling, 200 c. c. of ammonia-free distilled water are added, 20 c. c. of a solution of potassium sulphide (containing 40 grams sulphide per liter), and a fraction of a gram of powdered zinc. A quantity of semi-normal HCl solution more than sufficient to neutralize the ammonia obtained in the oxidation of the milk is now carefully measured out from a delicate burette (divided into $\frac{1}{20}$ c. c.) into an Erlenmeyer flask and the flask connected with a distillation apparatus. At the other end the Jena flask containing the watery solution of the ammonium sulphate is connected, after adding 50 c. c. of a concentrated soda solution (1 pound "pure potash" dissolved in 500 c. c. of distilled water and allowed

to settle); the contents of the Jena flask are now heated to boiling, and the distillation is continued for 40 minutes to an hour, until all ammonia has been distilled over.

The excess of acid in the Erlenmeyer receiving flask is then accurately titrated back by means of a tenth-normal standard ammonia solution, using a cochineal solution as an indicator. From the amount of acid used the per cent of nitrogen is obtained; and from it the per cent of casein and albumen in the milk by multiplying by 6.25. The amount of nitrogen contained in the chemicals used is determined by blank experiments and deducted from the nitrogen obtained as described. (Farrington and Woll, Testing Milk and Its Products, p. 221.)

82. *Coloring matter and preservatives.*—All certified milks and creams shall be free from adulteration, and coloring matter and preservatives shall not be added thereto.

83. Tests for the detection of added coloring matter shall be applied whenever the color of the milk or cream is such as to arouse suspicion.

Test for coloring matter.—The presence of foreign coloring matter in milk is easily shown by shaking 10 c. c. of the milk with an equal quantity of ether; on standing, a clear ether solution will rise to the surface; if artificial coloring matter has been added to the milk, the solution will be yellow colored, the intensity of the color indicating the quantity added; natural fresh milk will give a colorless ether solution. (Testing Milk and Its Products, Farrington and Woll, p. 244.)

84. Tests for the detection of formaldehyde, borax, and boracic acid shall be applied at least once each month. Occasionally application of tests for the detection of salicylic acid, benzoic acid, and the benzoates is also recommended.

Test for the detection of formaldehyde.—Five cubic centimeters of milk is measured into a white porcelain dish, and a similar quantity of water added; 10 c. c. of HCl, containing a trace of $Fe_2 Cl_6$, is added, and the mixture is heated very slowly. If formaldehyde is present, a violet color will be formed. (Testing Milk and Its Products, Farrington and Woll, p. 249.)

Test for boracic acid (borax, borates, preservaline, etc.).—One hundred cubic centimeters of milk are made alkaline with a soda or potash solution, and then evaporated to dryness and incinerated. The ash is dissolved in water, to which a little hydrochloric acid has been added, and the solution filtered. A strip of turmeric paper moistened with the filtrate will be colored reddish brown when dried at 100° C. on a watch glass, if boracic acid is present.

If a little alcohol is poured over the ash to which concentrated sulphuric acid has been added, and fire is set to the alcohol, after a little while this will burn with a yellowish-green tint, especially noticeable if the ash is stirred with a glass rod and when the flame is about to go out. (Testing Milk and Its Products, Farrington and Woll, p. 247.)

Test for salicylic acid (salicylates, etc.).—Twenty cubic centimeters of milk are acidulated with sulphuric acid and shaken with ether; the ether solution is evaporated, and the residue treated with alcohol and a little iron-chlorid solution; a deep violet color will be obtained in the presence of salicylic acid. (Testing Milk and Its Products, Farrington and Woll, p. 248.)

Test for benzoic acid.—Two hundred and fifty to five hundred cubic centimeters of milk are made alkaline with a few drops of lime or baryta water, and then evaporated to about a quarter of the bulk. Powdered gypsum is stirred into the remaining liquid until a paste is formed, which is then dried on the water bath. The gypsum only serves to hasten the drying, and powdered pumice stone or sand can be used equally well. When the mass is dry, it is finely powdered and moistened with dilute sulphuric acid and shaken out three or four times with about twice the volume of 50 per cent alcohol, in which benzoic acid is easily soluble in the cold, the fat only being dissolved to a very slight extent or not at all. The acid alcoholic liquid from the various extractions, which contains milk sugar and inorganic salts in addition to the benzoic acid, is neutralized with baryta water and evaporated to a small bulk. Dilute sulphuric acid is again added, and the liquid shaken out with small quantities of ether. On evaporation of the ether, the benzoic acid is left behind in almost pure state, the only impurities being small quantities of fat or ash.

The benzoic acid which is obtained is dissolved in a small quantity of warm water, a drop of sodium acetate and neutral ferric chloride added, and the red precipitate of benzoate of iron indicates the presence of the acid. (Milk and Dairy Products, Barthel; translated by Goodwin, p. 121.)

85. *Detection of heated milk.*—Certified milk or cream shall not be subjected to heat unless specially directed by the commission to meet emergencies.

86. Tests to determine whether such milks and creams have been subjected to heat shall be applied at least once each month.

Detection of heated milk—Storch's method.—Five cubic centimeters of milk are poured into a test tube; a drop of weak solution of hydrogen dioxide (about 0.2 per cent) which contains about 0.1 per cent sulphuric acid, is added, and two drops of a 2 per cent solution of paraphenylendiamin (solution should be renewed quite often), then the fluid is shaken. If the milk or the cream becomes, at once, indigo blue, or the whey violet or reddish brown, then this has not been heated or, at all events, it has not been heated higher than 78° C. (172.5° F.); if the milk becomes a light bluish gray immediately or in the course of half a minute, then it has been heated to 79° to 80° C. (174.2° to 176° F.). If the color remains white, the milk has been heated at least to 80° C. (176° F.). In the examination of sour milk or sour buttermilk, lime water must be added, as the color reaction is not shown in acid solution.

Arnold's guaiac method.—A little milk is poured into a test tube and a little tincture of guaiac is added, drop by drop. If the milk has not been heated to 80° C. (176° F.) a blue zone is formed between the two fluids; heated milk gives no reaction, but remains white. The guaiac tincture should not be used perfectly fresh, but should have stood a few days and its potency have been determined. Thereafter it can be used indefinitely. These tests for heated milk are only active in the case of milks which have been heated to 176° F. or 80° C. (Jensen's Milk Hygiene, Pearson's translation, p. 192.)

Microscopic test for heated (pasteurized) milk—Frost and Ravenel.—About 15 c. c. of milk are centrifuged for 5 minutes, or long enough to throw down the leucocytes. The cream layer is then completely removed with absorbent cotton and the milk drawn off with a pipette, or a fine-pointed tube attached to a Chapman air pump. Only about 2 mm. of milk are left above the sediment which is in the bottom of the sedimentation tube.

The stain, which is an aqueous solution of safranin O, soluble in water, is then added very slowly from an opsonizing pipette. The important thing is to mix stain and milk so slowly that clotting does not take place. The stain is added until a deep opaque rose color is obtained. After standing 3 minutes, by means of the opsonizing pipette, which has been washed out in hot water, the stained sediment is then transferred to slides. A small drop is placed at the end of each of several slides and spread by means of a glass spreader, as in Wright's method for opsonic index determinations.

In an unheated milk the polymorphonuclear leucocytes have their protoplasm slightly tinged or are unstained.

In heated milk the polymorphonuclear leucocytes have their nuclei stained. In milk heated to 63° C. or above, practically all of the leucocytes have their nuclei definitely stained. When milk is heated at a lower temperature the nuclei are not all stained above 60° C. The majority, however, are stained.

87. *Specific gravity.*—The specific gravity of certified milk shall range from 1.029 to 1.034.

88. The specific gravity shall be determined at least each month.

The Quevenne lactodensimeter is recommended for the determination of the specific gravity. It is made like an ordinary aerometer and divided into degrees which correspond to a specific gravity from 1.014 to 1.040, or only 1.022 to 1.038, since by the latter division a greater space is gained between the different degrees without unduly lengthening the instrument. From such a lactodensimeter one can easily read off four decimal places.

The milk the specific gravity of which is to be determined is well shaken and poured into a high glass cylinder of suitable diameter; the aerometer is dropped in slowly, in order to prevent its bobbing up and down. (The bulb should be free from adhering air bubbles.) The figures on the stem are the second and third decimals of the numbers of the specific gravity, so that 34 is to be read 1.034. For this examination, the temperature of the milk must be 15° C.

(60° F.); if it is not, the specific gravity of the milk at 15° C. must be calculated from the specific gravity found and from the temperature, for in milk inspection and analysis this is the standard.

METHODS AND REGULATIONS FOR THE MEDICAL EXAMINATION OF EMPLOYEES THEIR HEALTH AND PERSONAL HYGIENE.

89. A medical officer, known as the attending dairy physician, shall be selected by the commission, who should reside near the dairy producing certified milk. He shall be a physician in good standing and authorized by law to practice medicine; he shall be responsible to the commission and subject to its direction. In case more than one dairy is under the control of the commission and they are in different localities, a separate physician should be designated for employment for the supervision of each dairy.

90. Before any person shall come on the premises to live and remain as an employee, such person, before being engaged in milking or the handling of milk, shall be subjected to a complete physical examination by the attending physician. No person shall be employed who has not been vaccinated recently or who upon examination is found to have a sore throat, or to be suffering from any form of tuberculosis, venereal disease, conjunctivitis, diarrhea, dysentery, or who has recently had typhoid fever or is proved to be a typhoid carrier, or who has any inflammatory disease of the respiratory tract, or any suppurative process or infectious skin eruption, or any disease of an infectious or contagious nature, or who has recently been associated with children sick with contagious disease.

91. In addition to ordinary habits of personal cleanliness all milkers shall have well-trimmed hair, wear close-fitting caps, and have clean-shaven faces.

92. When the milkers live upon the premises their dormitories shall be constructed and operated according to plans approved by the commission. A separate bed shall be provided for each milker and each bed shall be kept supplied with clean bedclothes. Proper bathing facilities shall be provided for all employees on the dairy premises, preferably a shower bath, and frequent bathing shall be enjoined.

93. In case the employees live on the dairy premises a suitable building shall be provided to be used for the isolation and quarantine of persons under suspicion of having a contagious disease.

The following plan of construction is recommened:

The quarantine building and hospital should be one story high and contain at least two rooms, each with a capacity of about 6,000 cubic feet and containing not more than three beds each, the rooms to be separated by a closed partition. The doors opening into the rooms should be on opposite sides of the building and provided with locks. The windows should be barred and the sash should be at least 5 feet from the ground and constructed for proper ventilation. The walls should be of a material which will allow proper disinfection. The floor should be of painted or washable wood, preferably of concrete, and so constructed that the floor may be flushed and properly disinfected. Proper heating, lighting, and ventilating facilities should be provided.

94. In the event of any illness of a suspicious nature the attending physician shall immediately quarantine the suspect, notify the health authorities and the secretary of the commission, and examine each member of the dairy force, and in every inflammatory affection of the nose or throat occurring among the employees of the dairy, in addition to carrying out the above-mentioned program, the attending physician shall take a culture and have it examined at once by a competent bacteriologist approved by the commission. Pending such examination, the affected employee or employees shall be quarantined.

95. It shall be the duty of the secretary, on receiving notice of any suspicious or contagious disease at the dairy, at once to notify the committee having in charge the medical supervision of employees of the dairy farm upon which such

disease has developed. On receipt of the notice this committee shall assume charge of the matter, and shall have power to act for the commission as its judgment dictates. As soon as possible thereafter, the committee shall notify the commission, through its secretary, that a special meeting may be called for ultimate consideration and action.

96. When a case of contagious disease is found among the employees of a dairy producing certified milk under the control of a medical milk commission, such employee shall be at once quarantined and as soon as possible removed from the plant, and the premises fumigated.

When a case of contagion is found on a certified dairy it is advised that a printed notice of the facts shall be sent to every householder using the milk, giving in detail the precautions taken by the dairyman under the direction of the commission, and it is further advised that all milk produced at such dairy shall be heated at 145° F. for 40 minutes, or 155° F. for 30 minutes, or 167° F. for 20 minutes, and immediately cooled to 50° F. These facts should also be part of the notice, and such heating of the milk should be continued during the accepted period of incubation for such contagious disease.

The following method of fumigation is recommended:

After all windows and doors are closed and the cracks sealed by strips of paper applied with flour paste, and the various articles in the room so hung or placed as to be exposed on all sides, preparations should be made to generate formaldehyde gas by the use of 20 ounces of formaldehyde and 10 ounces of permanganate of potash for every 1,000 cubic feet of space to be disinfected.

For mixing the formaldehyde and potassium permanganate a large galvanized-iron pail or cylinder holding at least 20 quarts and having a flared top should be used for mixing therein 20 ounces of formaldehyde and 10 ounces of permanganate. A cylinder at least 5 feet high is suggested. The containers should be placed about in the rooms and the necessary quantity of permanganate weighed and placed in them. The formaldehyde solution for each pail should then be measured into a widemouthed cup and placed by the pail in which it is to be used.

Although the reaction takes place quickly, by making preparations as advised all of the pails can be "set off" promptly by one person, since there is nothing to do but pour the formaldehyde solution over the permanganate. The rooms should be kept closed for four hours. As there is a slight danger of fire, the reaction should be watched through a window or the pails placed on a noninflammable surface.

97. Following a weekly medical inspection of the employees, a monthly report shall be submitted to the secretary of the medical milk commission, on the same recurring date by the examining visiting physician.

The following schedule, filled out in writing and signed by himself, is recommended as a suitable form for the attending physician's report:

This is to certify that, on the dates below indicated, official visits were made to the ——— dairy, owned and conducted by ——— of ——— (indicating town and State), where careful inspections of the dairy employees were made.

(*a*) Number and dates of visits since last report. ———.

(*b*) Number of men employed on the plant. ———.

(*c*) Has a recent epidemic of contagion occurred near the dairy, and what was its nature and extent? ———.

(*d*) Have any cases of contagious or infectious disease occurred among the men since the last report? ———.

(*e*) Disposition of such cases. ———.

(*f*) What individual sickness has occurred among the men since the last report? ———.

(*g*) Disposition of such cases. ———.

(*h*) Number of employees now quarantined for sickness. ———.

(*i*) Describe the personal hygiene of the men employed for milking when prepared for and during the process of milking. ———.

(*j*) What facilities are provided for sickness in employees? ———.

(*k*) General hygienic condition of the dormitories or houses of the employees. ———.

(*l*) Suggestions for improvement. ———.

(*m*) What is the hygienic condition of the employees and their surroundings? ———.

(*n*) How many employees were examined at each of the foregoing visits? ———.

(*o*) Remarks.

———— ————,
Attending Physician.

Date, ———.

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